REMARKS

The applicant has carefully considered the Office action dated February 10, 2005 and the reference it cites. By way of this Response, claim 1 has been amended. In view of the following, it is respectfully submitted that all pending claims are in condition for allowance and favorable reconsideration is respectfully requested.

Objections to the Drawings

Figures 1A-1D have been amended to include required prior art legends.

Objection to Claim 1

Claim 1 has been amended to include a proper antecedent basis of an "upper metal layer."

35 U.S.C. § 103 Rejections

Claim 1 recites a method of removing polymer that is generated during the manufacturing process of semiconductors. The manufacturing process includes sequentially depositing a lower metal layer, an insulating layer and an upper layer on a semiconductor substrate. Then a photoresist pattern is formed on the upper metal layer and is used as a mask to etch the upper metal layer and insulating layers. During the etching step, the polymer is generated. The method of removing the polymer includes removing the photoresist pattern using O_2/N_2 plasma and removing the polymer existing on the lower metal layer by using H_2O/CF_4 plasma. Claim 8 recites a method of manufacturing a semiconductor device that has a capacitor. The method of claim 8 includes sequentially depositing a lower metal layer, an insulating layer and an upper layer on a semiconductor substrate, and forming a first photoresist pattern on the upper metal layer, which is used as a mask to etch the upper metal layer and the insulating layer to form an upper electrode film and a capacitor insulating film. The first photoresist pattern is removed using O_2/N_2 plasma, and the polymer existing on the lower metal layer is removed using H_2O/CF_4 plasma. A second photoresist pattern for completely encapsulating the upper electrode film and the capacitor insulating film is formed and is used as a mask to etch the lower metal layer to form a lower electrode film. The second photoresist pattern is removed to provide the capacitor including the lower electrode film, the capacitor insulating film and the upper electrode film.

The Office action rejected claims 1-3, and 8 under 35 U.S.C. § 103 as being unpatentable over admitted prior art U.S. Pat. 6,599,829 to Smith ("Smith"). The Office action states that the admitted prior art discloses manufacturing a semiconductor device having a capacitor by sequentially depositing a lower metal layer, an insulating layer, an upper metal layer, a photoresist pattern, etching, forming a second photoresist pattern, and a lower electrode. The Office action concedes that the admitted prior art does not disclose using O_2/N_2 plasma nor removing the polymer using H_2O/CF_4 plasma. To cure the deficiencies of the admitted prior art, the Office action uses Smith. In particular, the Office action states that Smith teaches the use of an O_2/N_2 plasma for photoresist removal and the use of a H_2O/CF_4 plasma for removal of a polymer residue. Thus, the Office action concludes, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use O_2/N_2 plasma to efficiently remove photoresist, and to use H_2O/CF_4 plasma to remove polymer residue from the metal structure. Further, the Office action states that the time and flow rate may be optimized based on the thickness of the photoresist layer and to prevent quartz erosion in the process chamber.

The Office action states that Smith discloses using O_2/N_2 plasma. Smith does not. Smith discloses an O_2/H_2O plasma passivation and photoresist strip step following by an *in situ* O_2/CF_4 or H_2O/CF_4 plasma cleaning step to remove polymer residues from a metal structure (col. 2, line 5-12). O_2/H_2O plasma is not O_2/N_2 plasma.

Because neither Smith nor the other admitted prior art discloses the use of O_2/N_2 plasma, the combinations used as the bases for the obviousness rejections do not teach or suggest all of the claim limitations. "To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." M.P.E.P. 2143.03. "All of the words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Royka*, 490 F.2d 981 (C.C.P.A. 1974). Consequently, the obviousness rejection for claims 1-3 and 8 cannot stand and the claims are in condition for allowance.

Further, Smith differs from the claimed invention in several ways. First, the composition of the plasma in Smith is different from the plasma described in the present invention. That is, Smith uses O_2/H_2O plasma instead of O_2/N_2 plasma. The properties of O_2/N_2 plasma are much different from those of O_2/H_2O plasma. For example, O_2/H_2O

plasma oxides much better than O_2/N_2 plasma. In the present invention, there is no need to use a plasma gas whose oxidizing power is strong enough to passivate a material like in Smith. Therefore, using O_2/N_2 plasma, instead of O_2/H_2O plasma, would not have been obvious to a person skilled in the art.

Second, the O_2/H_2O plasma of Smith is intended for much different functions than the O_2/N_2 plasma of the present invention. The O_2/N_2 plasma of the present invention simply removes a photoresist, while the O_2/H_2O plasma of Smith not only removes a photoresist, but also passivates a metal.

Further, Smith discloses removing photoresist and other residues with a hydrogen containing plasma (col. 7, lines 16-18).

In addition, the claimed methods of removing a polymer generated in a semiconductor manufacturing process, include two steps which are (a) removing a photoresist pattern by using O_2/N_2 plasma, and (b) removing the polymer existing on the lower metal layer by using H_2O/CF_4 plasma (see claims 1 and 8). On the other hand, Smith includes just one step which will passivate most metal structures, remove the polymeric residues from sidewalls of the metal structures, and will remove the photoresist at once (col. 2, line 36-39).

Finally, the present invention uses O_2/N_2 and H_2O/CF_4 gases, while the gases that are used to achieve the above results in Smith are selected from one of the following: NH_3, N_2H_2, H_2S, CH_4 and deuterated forms of these gases. Additionally, the gases used in Smith may include a forming gas, which is comprised of a gas consisting of argon, nitrogen and any other inert gas (col. 2, line 59 to col. 3 line 1). Thus, nitrogen may or may not be included – it is nonessential. Further there is no reference about oxygen. Also, the background of Smith describes problems concerning erosion of process equipment by fluorine plasma (col. 2, lines 12-15). This description is an indication that Smith intended to exclude such gasses, like H_2O/CF_4, which may generate fluorine plasma.

Accordingly, Smith neither teaches, suggests, nor discloses any of the inventive features of the claims in this application. Therefore, it is respectfully submitted that the claims define a patentable invention over Smith, and therefore, are allowable.

Objections to Claims 4-7, 9

Claims 4-7, 9 were objected to as being dependent upon their respective rejected base claims. Because the rejection under 35 U.S.C. § 103 was improper and the claims are in allowable form, this objection is unwarranted.

Conclusion

No combination of the prior art teaches or suggests all of the claim limitations of claims 1-3 and 8. Therefore, the *prima facie* case of obviousness has not been established. Based on the foregoing, all claims are now in condition for allowance and favorable reconsideration is respectfully requested.

Respectfully submitted,

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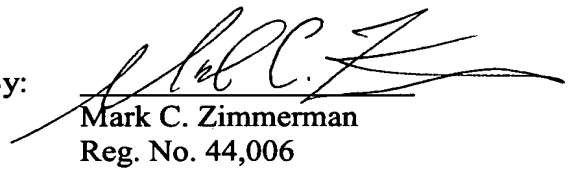
By: 

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